One-mm 3D Laser Imaging Survey for Comprehensive Runway Evaluation

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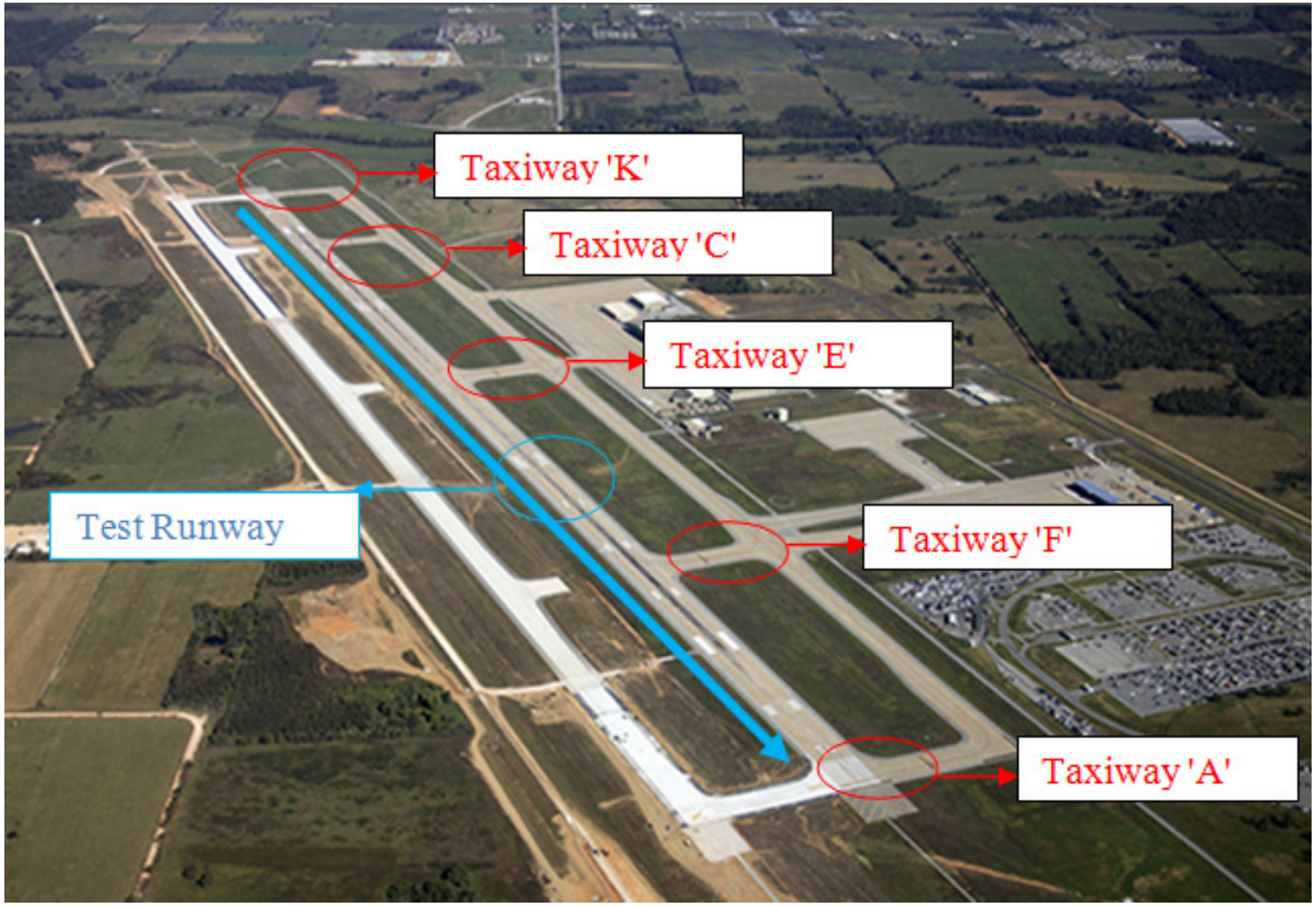
Full Size Runway 16-34



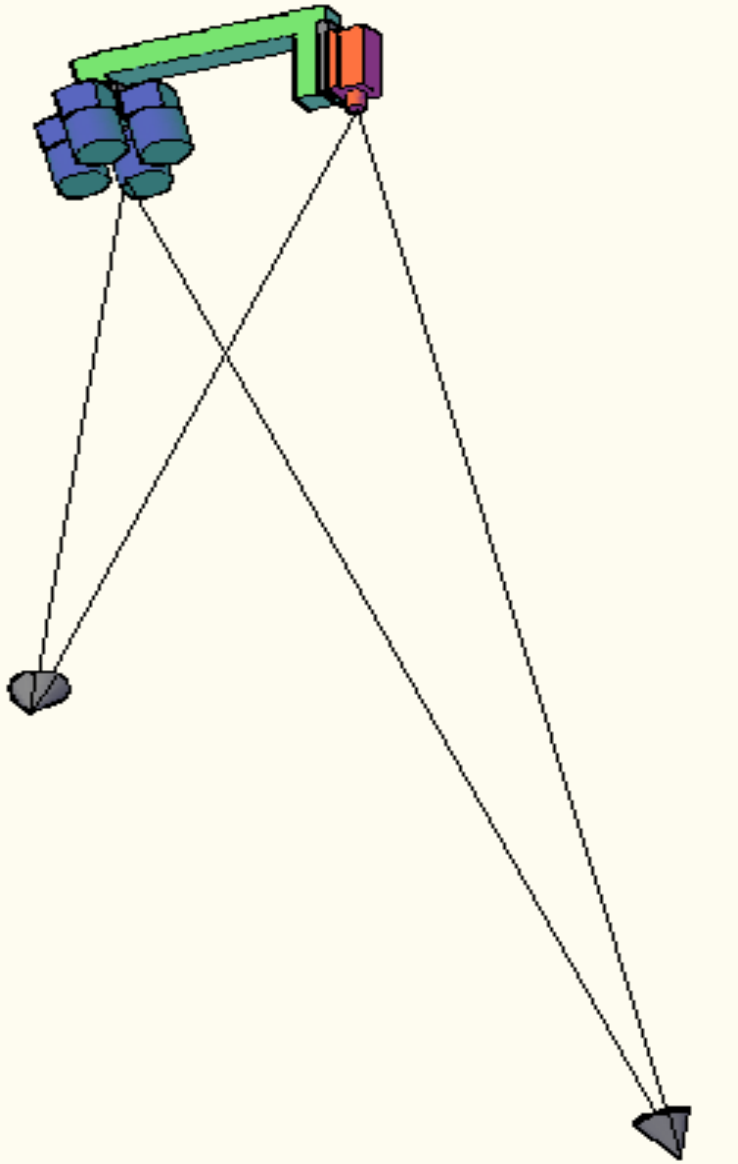
Full Size Runway 16-34

Evaluation Objectives

- PaveVision3D Ultra imaging of runway and taxiways at 1mm resolution
- PCI analysis
- Longitudinal profiling
  - Boeing Bump Index (BBI)
- Runway groove identification, measurement, evaluation
- Transverse profiling

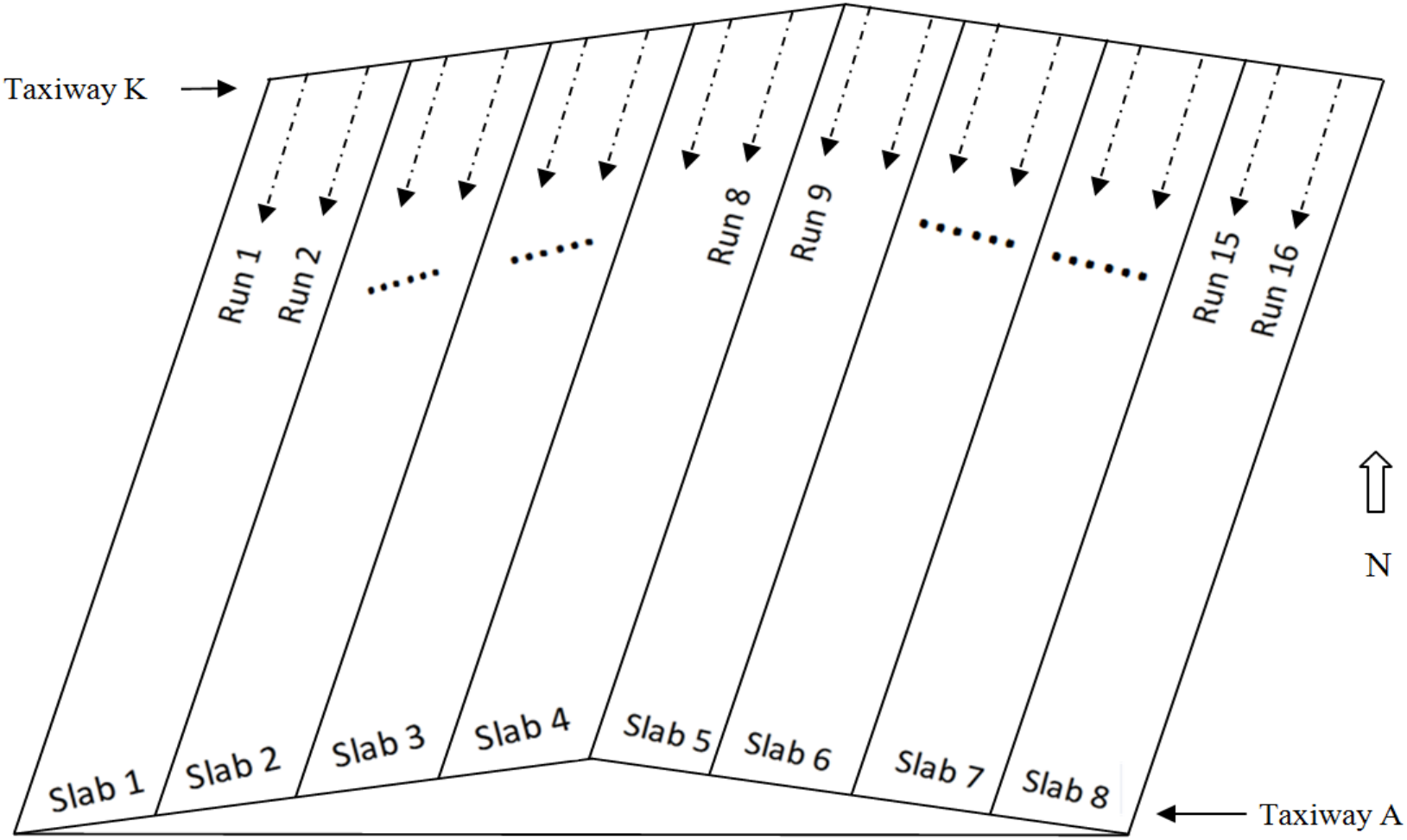
PaveVision3D Ultra Systems

3D Ultra Data Collection System

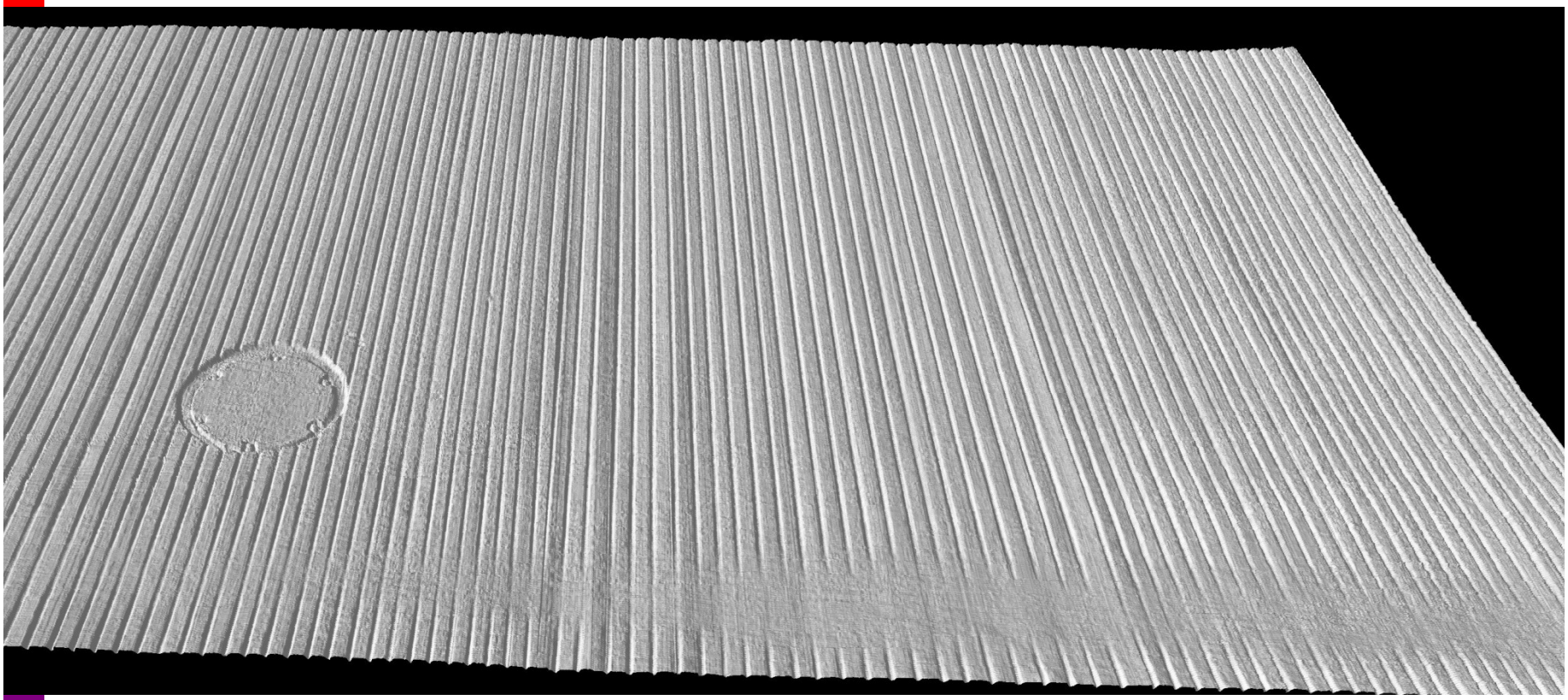


Data Collection Techniques

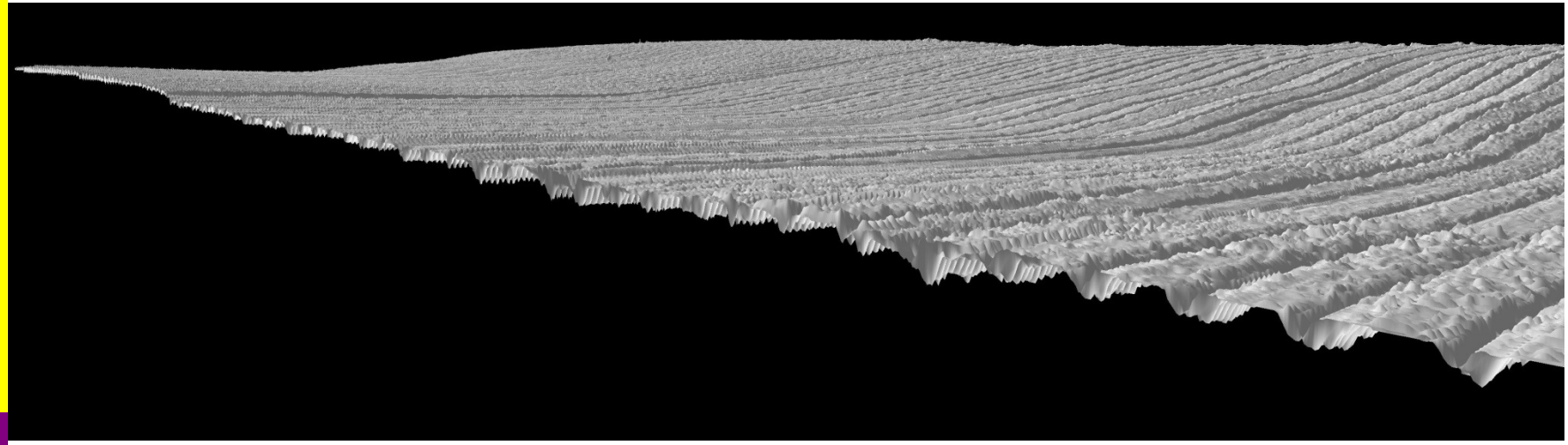
Data Collection Summary



3D Ultra Data



3D Ultra Data



Runway Surface Examination

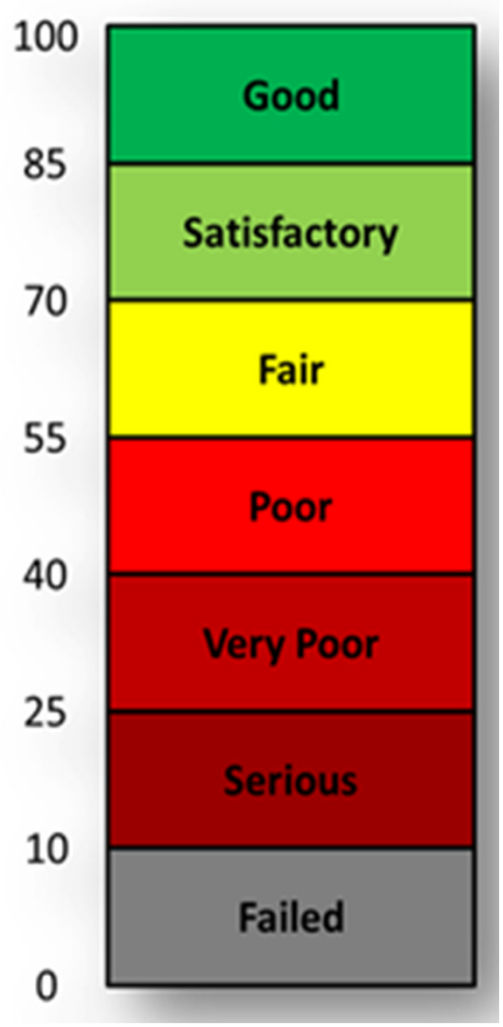
- Reference Station 6000ft to the intersection of runway and taxiway F
- 61 runs of transverse 1mm 3D Ultra data (953 frames)
- Analysis tool: MHIS-3D
- Key surface defects
  - Surface irregularity
  - Popouts
  - Joint spalling
  - Faulting
  - Patching
  - Scaling
  - Excessive grinding
  - Grooving problems

Surface Evaluation Results

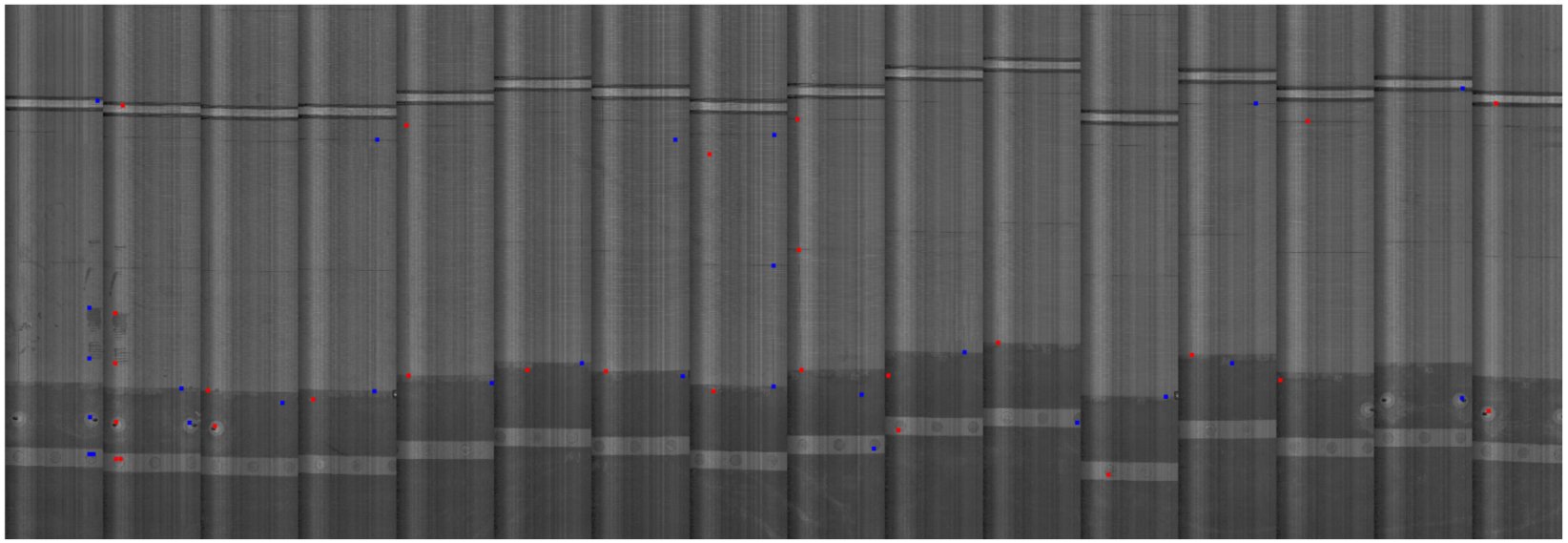
Surface Defect	Total % of Frames
Surface Irregularity	30.64
Popouts	42.60
Joint Spalling	16.78
Faulting	10.08
Patching	6.08
Scaling	11.96
Excessive Grinding	12.69
Missing Grooves	1.36

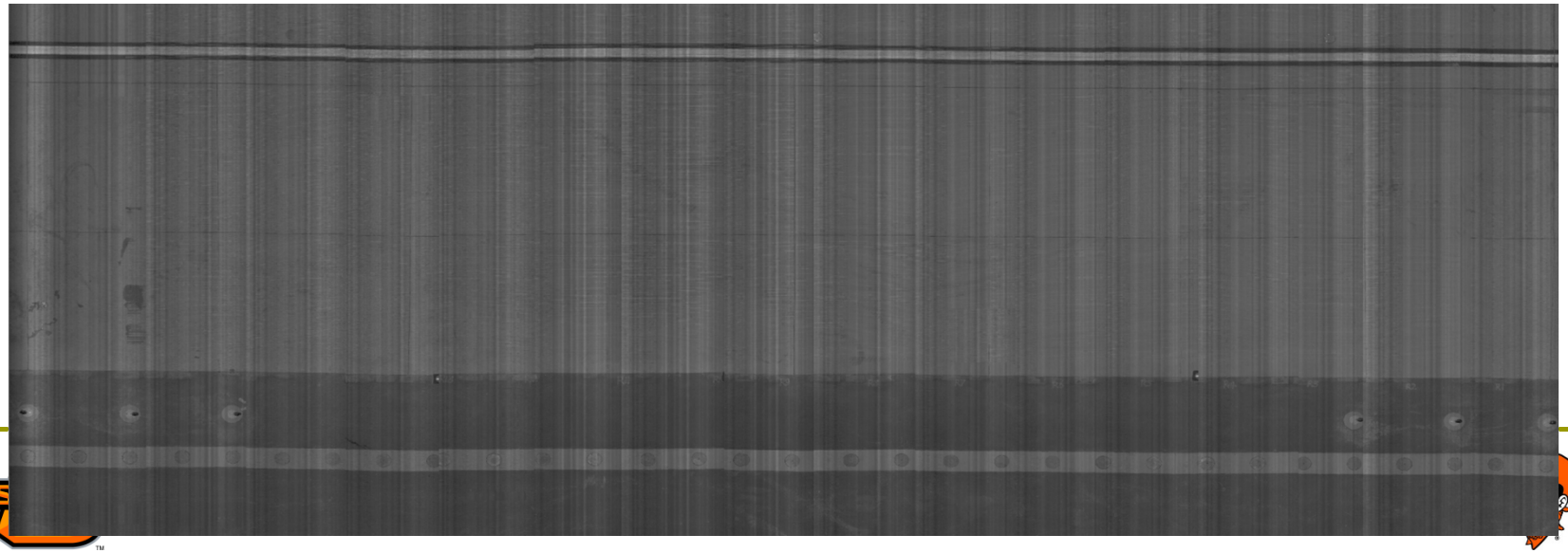
Airport PCI Analysis

- PCI – Pavement Condition Index
- Quantitative Measure of Pavement Condition
- FAA AC 150/5380-6A (ASTM D5340-03)
- Pavement distress
  - Type
  - Quantity
  - Severity

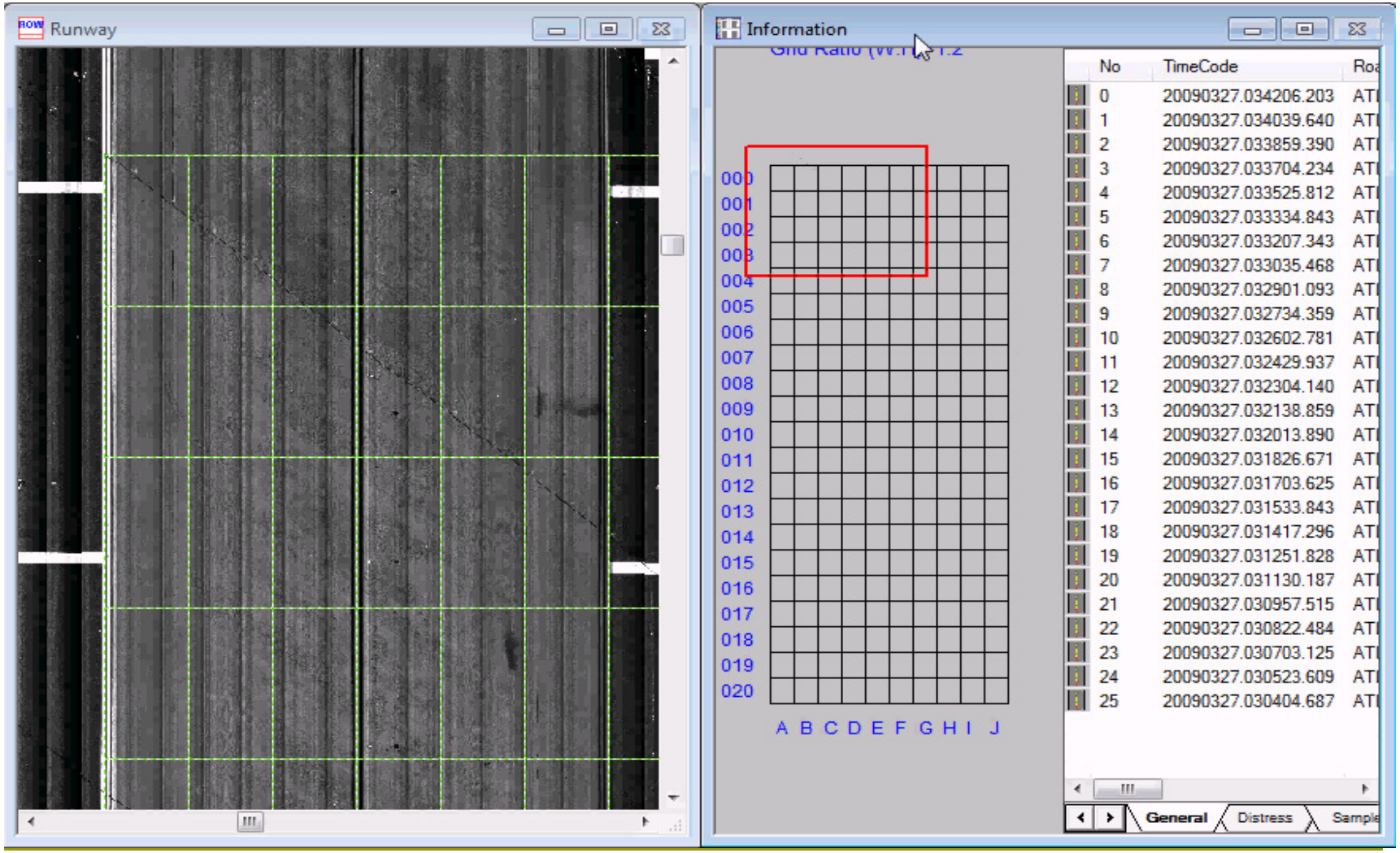


MHIS-Airport2D: Stitching

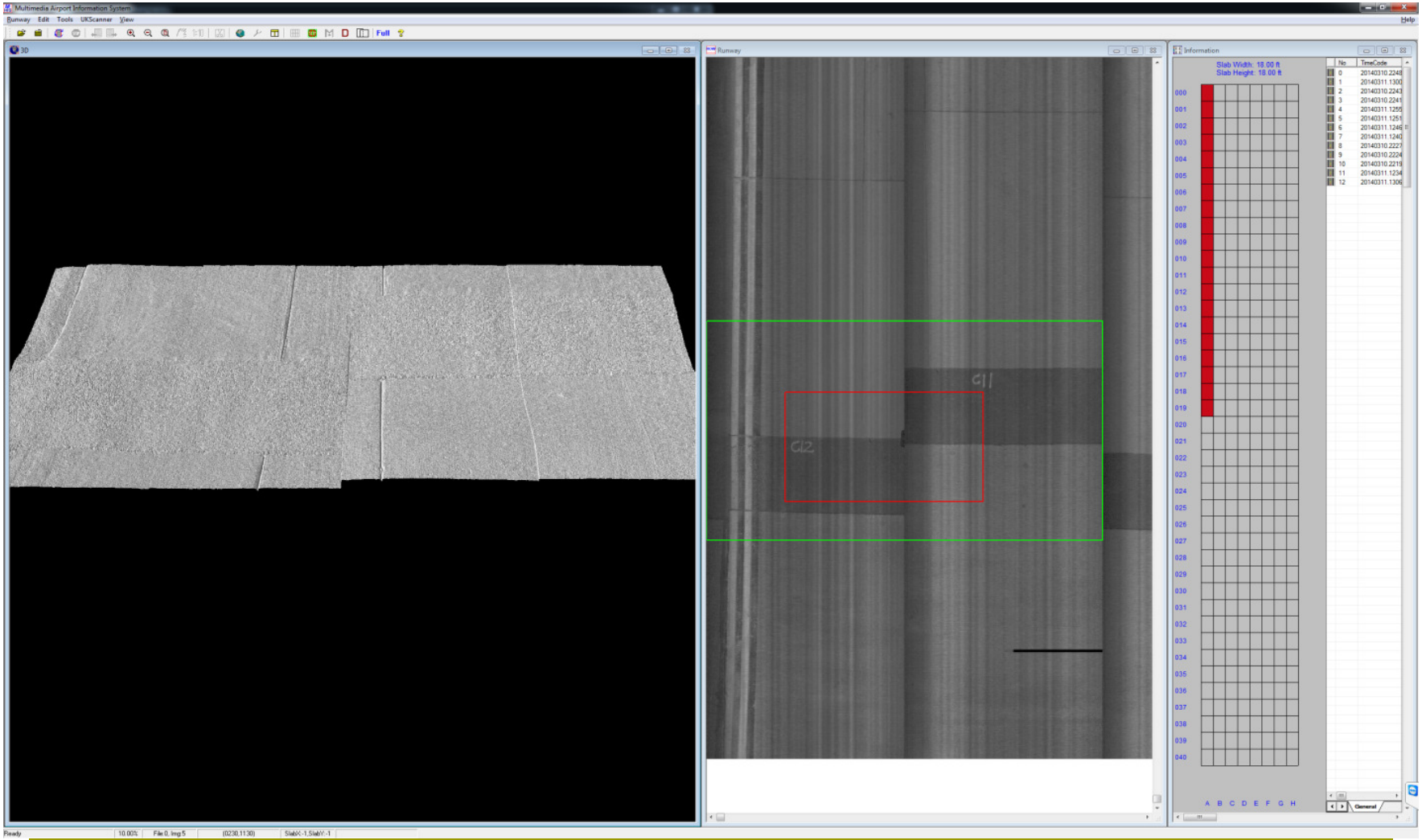




MHIS-Airport2D: PCI Analysis



MHIS-Airport3D Interface



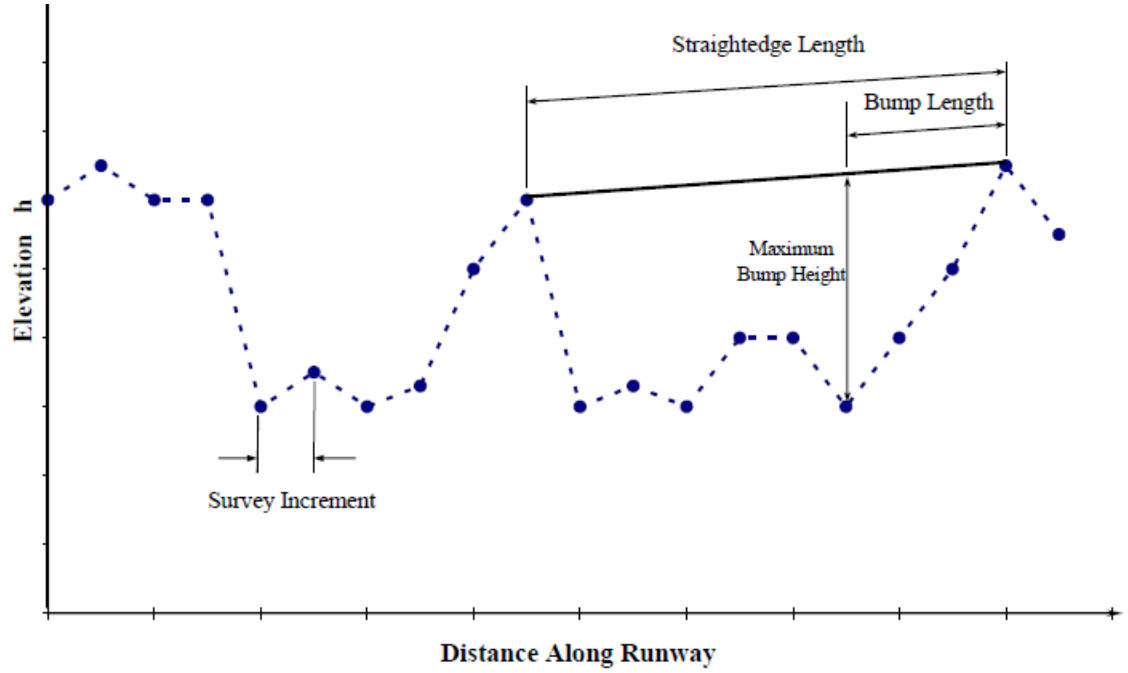
PCI Results

Location		PCI
Runway Overall		91
Runway Segment	Taxiway K-C	92
	Taxiway C-E	89.3
	Taxiway E-F	92.8
	Taxiway F-A	90.7

- PCI: excellent condition
- MHIS-Airport: only 2D capability
- Many surface issues: not in PCI procedure
  - Surface irregularity
  - Groove problems
  - Surface grinding
  - Construction problems

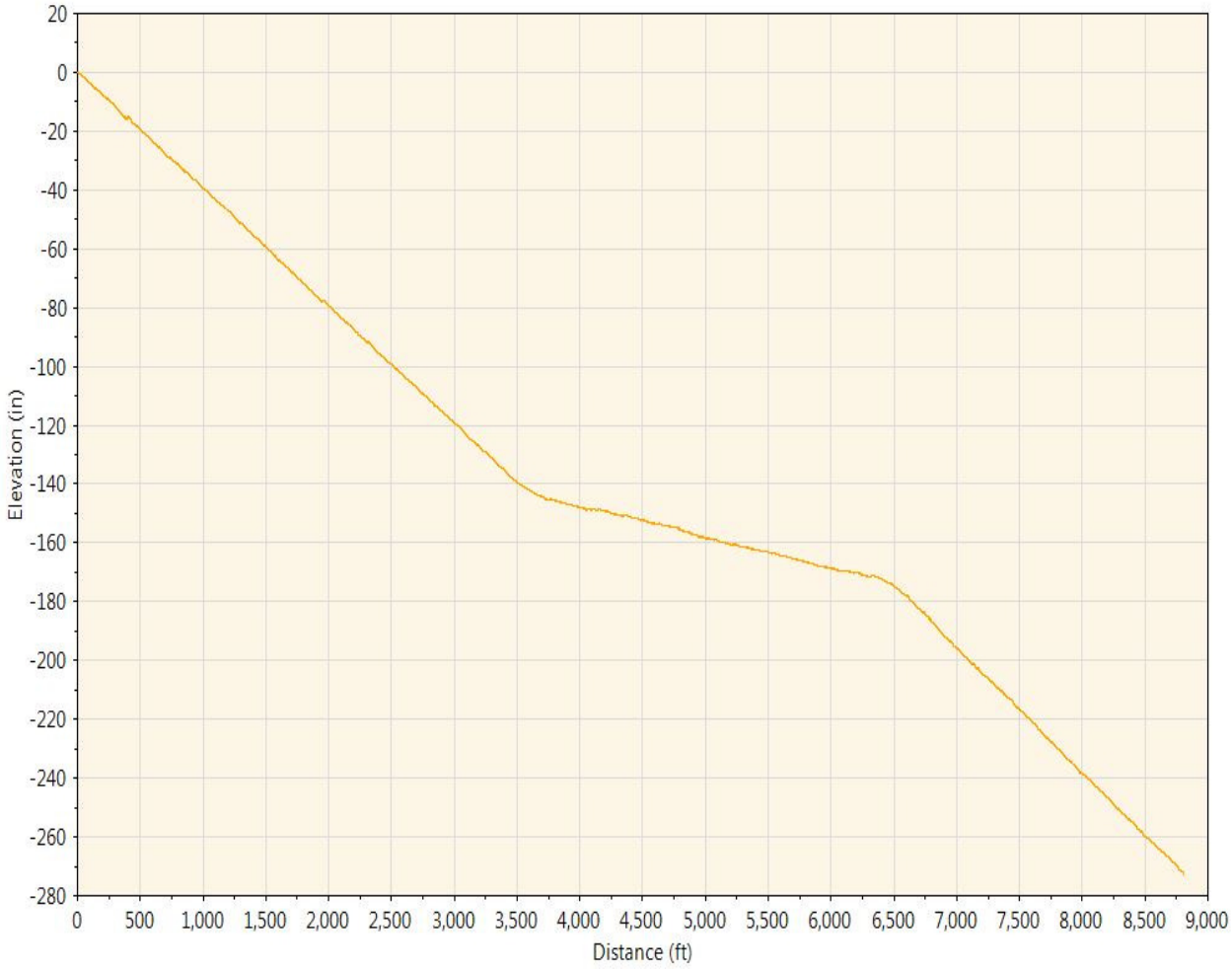
Runway Longitudinal Profiling

- Boeing Bump Methodology
  - FAA AC 150/5380-9



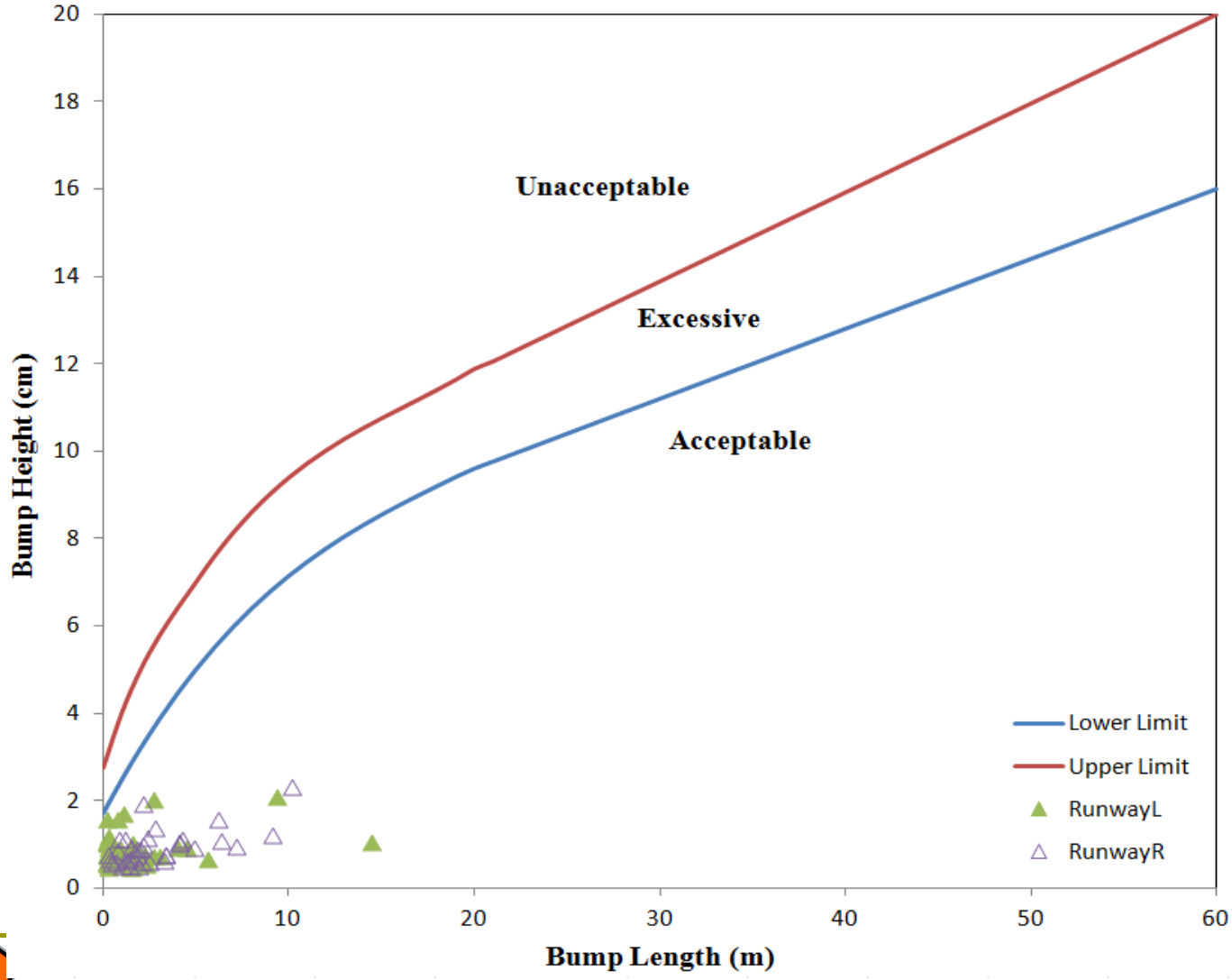
BBI = (measured bump height) / (limit of acceptable bump height)

Example Longitudinal Profile

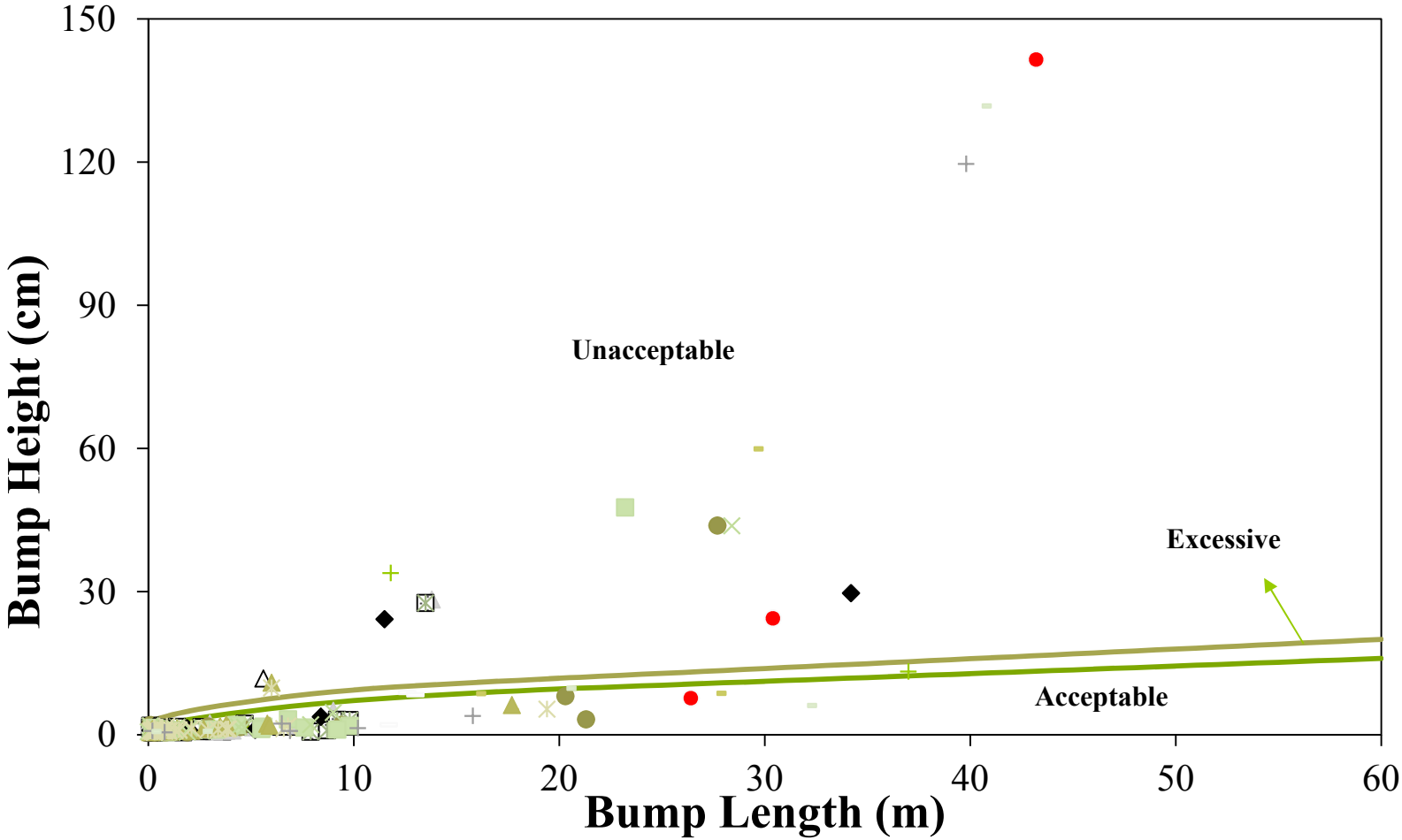


- Runway length: 8795 ft (8800ft designed)
- Elevation difference: 22.7ft (23 ft designed)

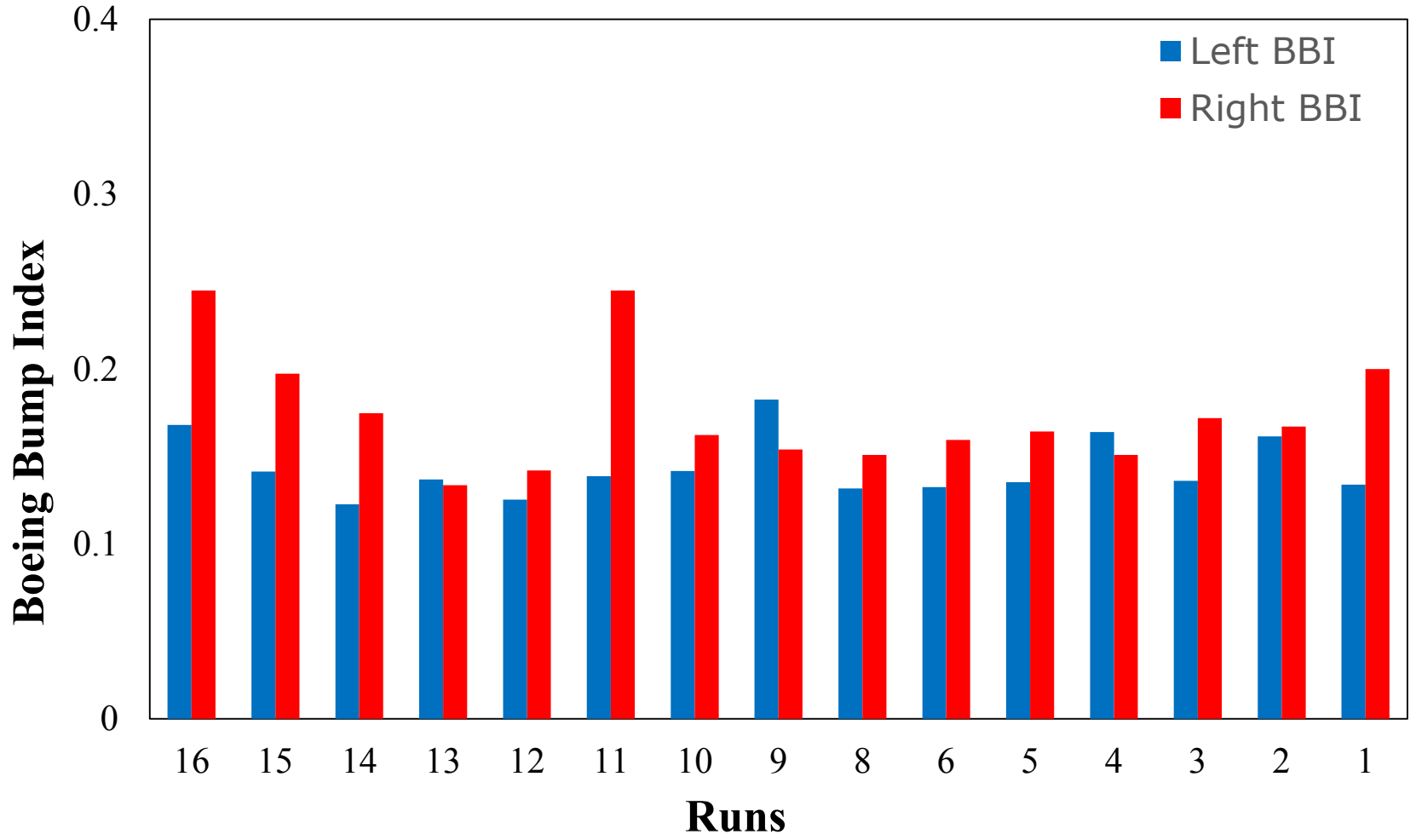
Runway Boeing Bumps



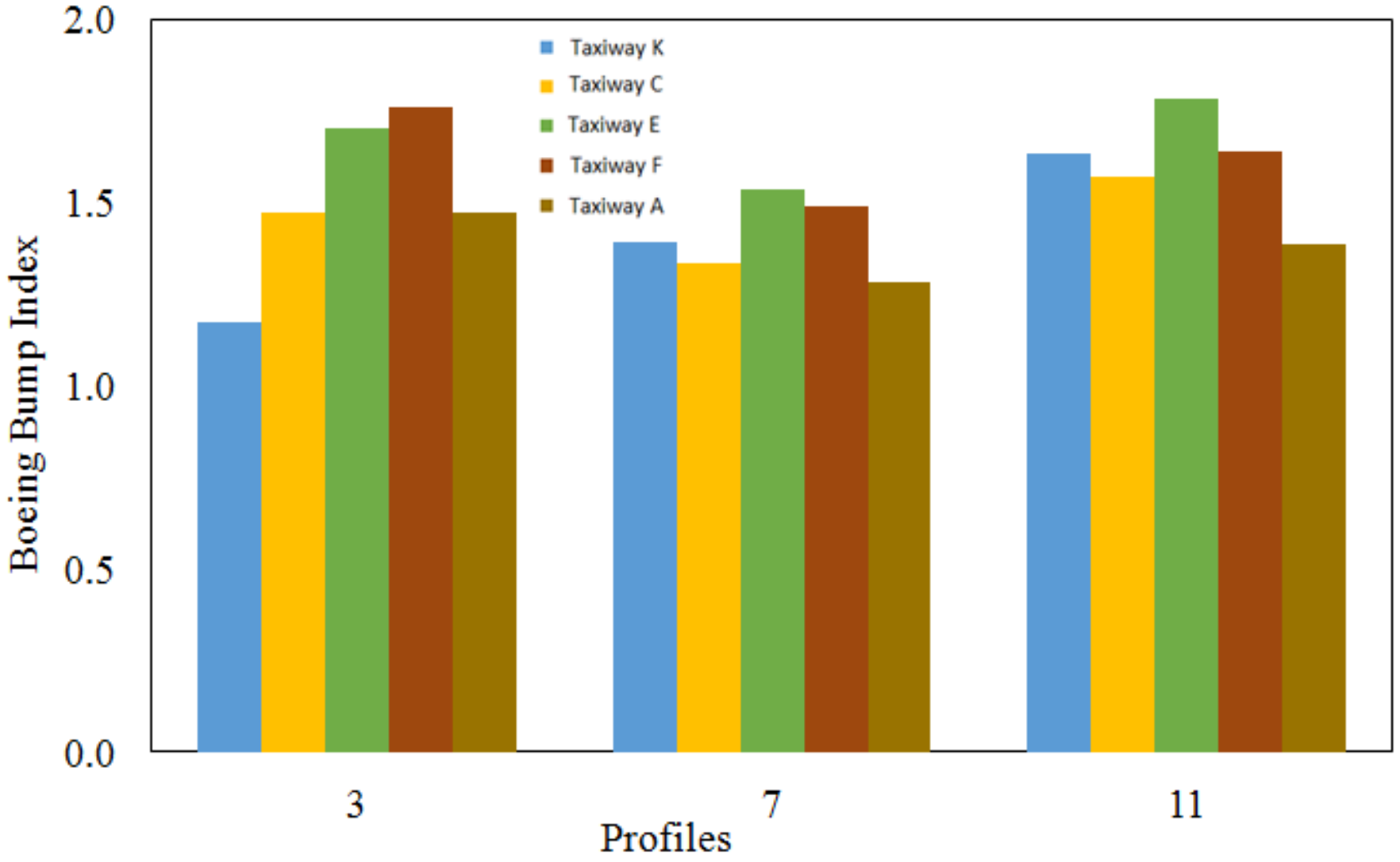
Taxiway Boeing Bumps



Runway BBI Results

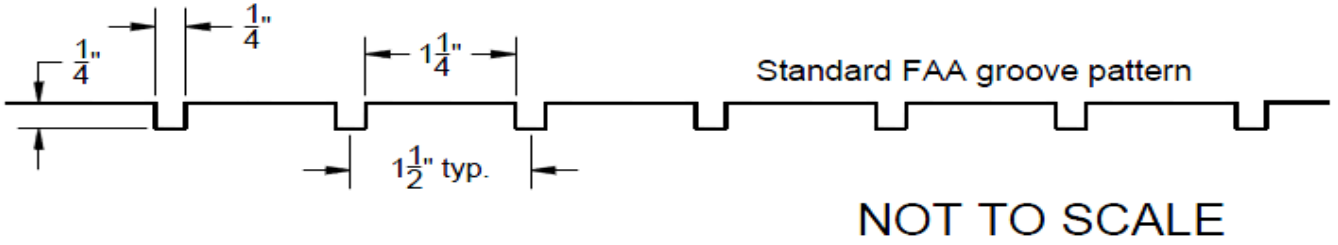


Taxiway BBI Results



Runway Groove Evaluation

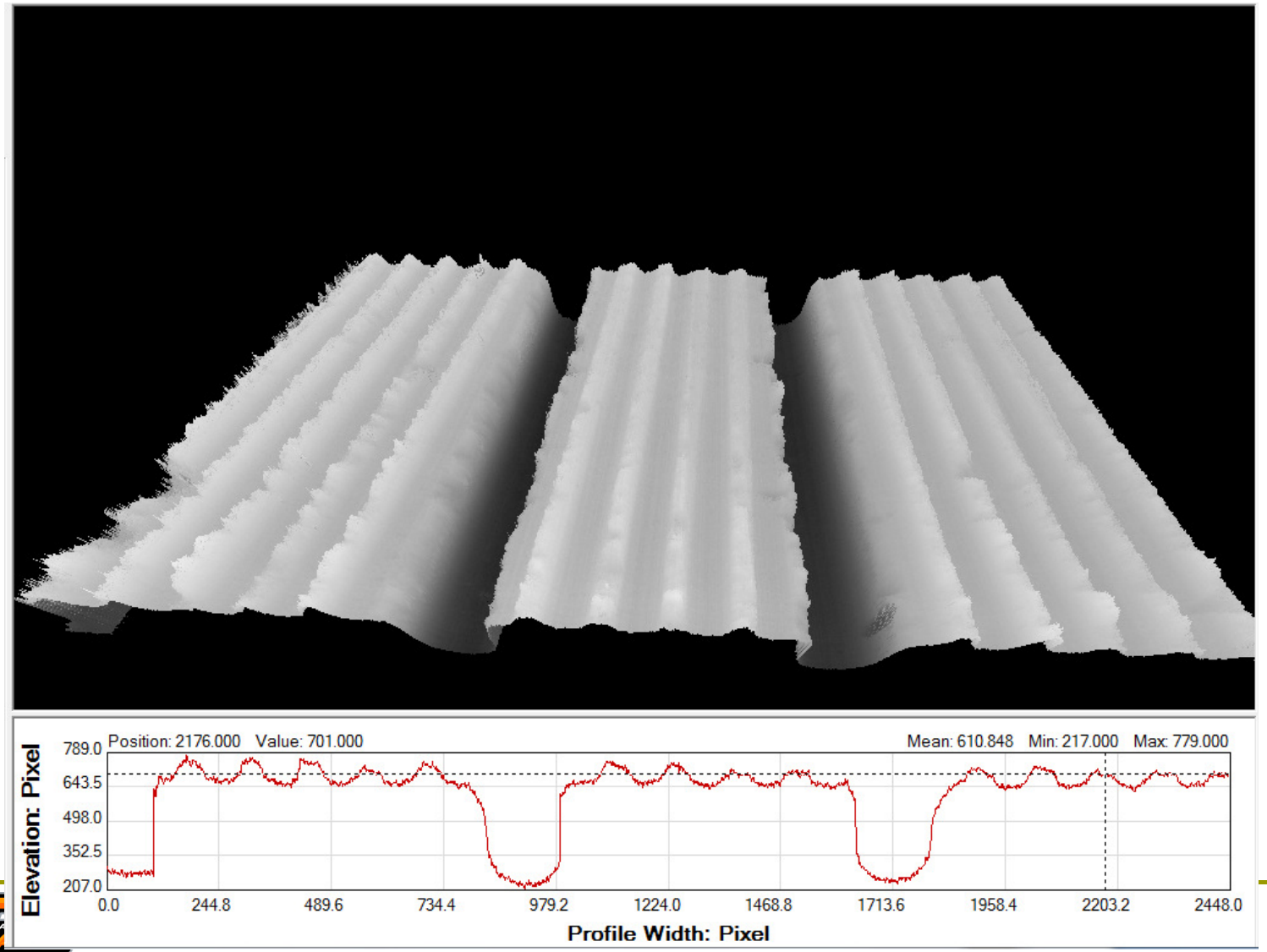
- Standard Rectangle Groove (AC 150/5320-12C)



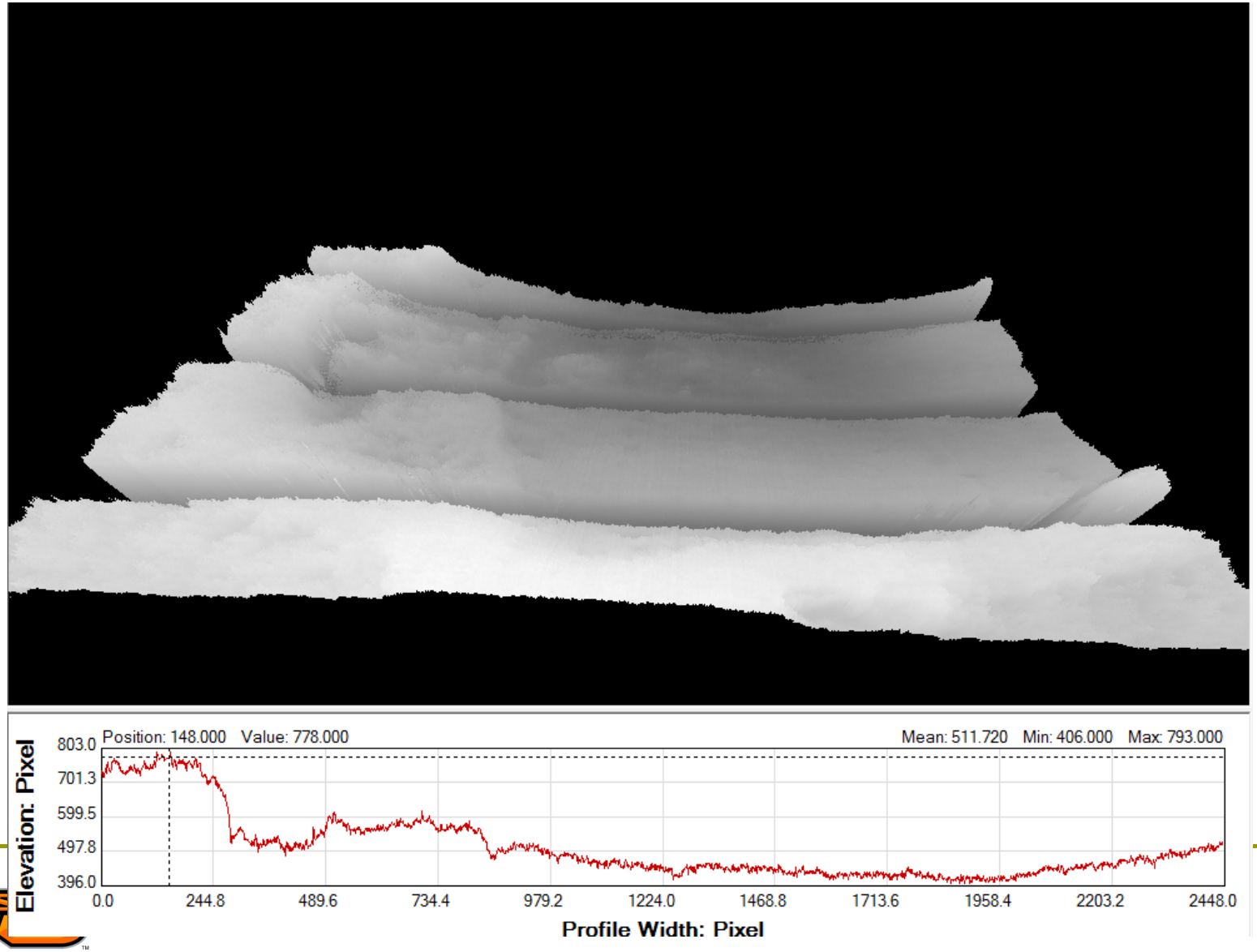
- Groove Tolerance

Groove type	Recommended configuration (Unit: in)		Tolerance (Unit: in)		Acceptable range			
			Lower limit	Upper limit	Unit: inch		Unit: mm	
Rectangular	Depth	1/4	-1/16	1/16	0.19	0.31	4.76	7.94
	Width	1/4	0	1/16	0.25	0.31	6.35	7.94
	Spacing	1 1/2	-1/8	0	1.38	1.5	34.9	38.1

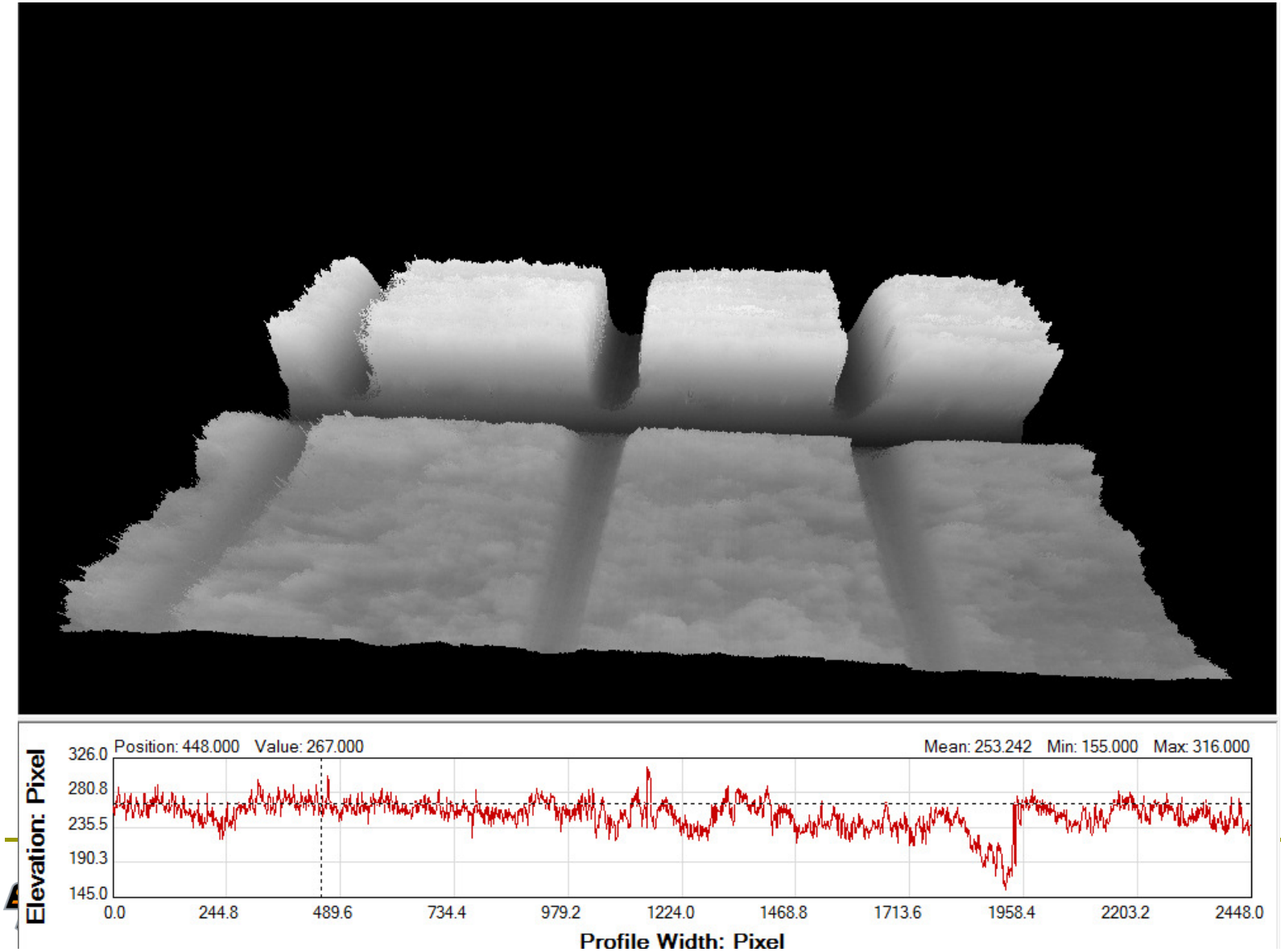
LS-40 Data – Grinded Surface



LS-40 Data – Grinded Surface



LS-40 Data – Uneven Surface

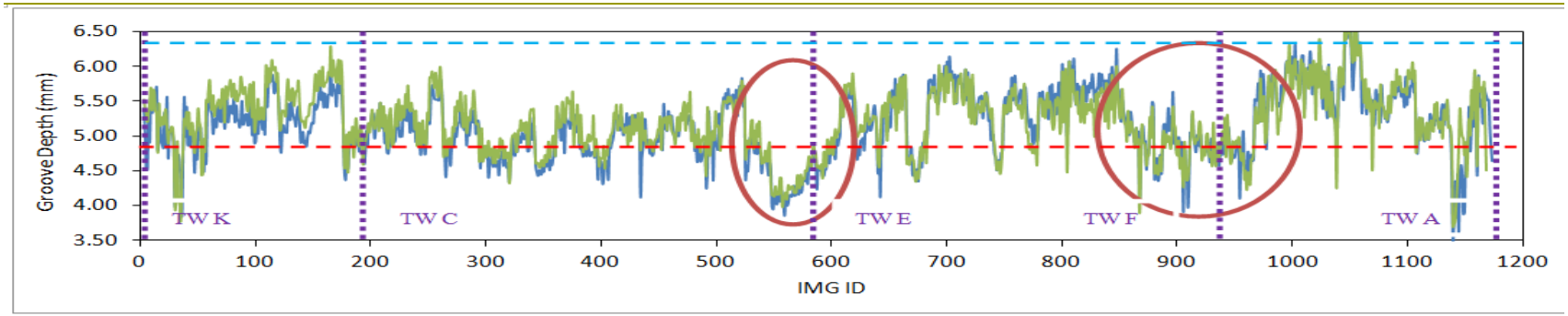


Grooving Software

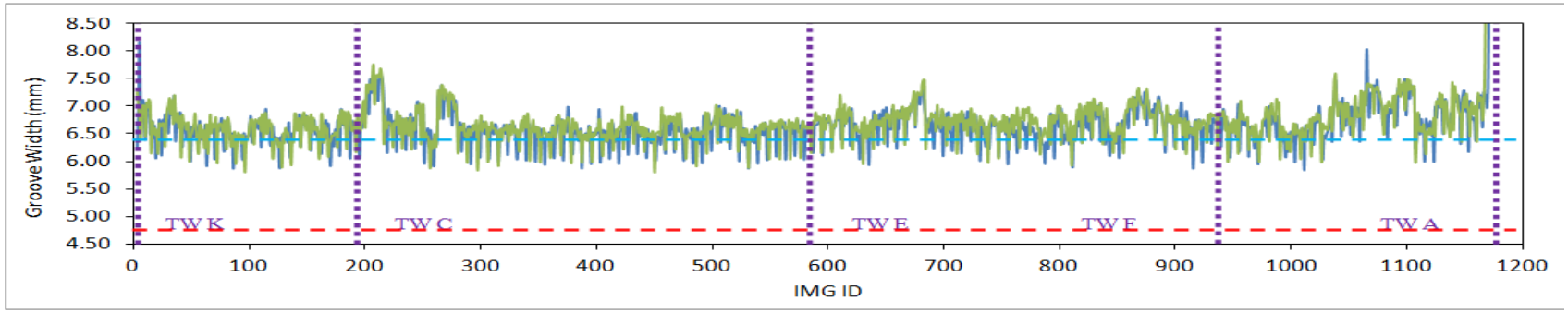
SiteNo	Mileage	LGroNum	LDepth	LWidth	LSpace	RGroNum	RDepth	RWidth
1	2.29	53.80	4.04	8.94	37.68	56.65	4.03	8.59
2	4.57	60.50	4.24	9.42	37.71	60.09	4.29	9.15
3	6.86	53.55	4.19	9.38	37.45	55.37	3.99	8.99
4	9.14	60.05	3.90	8.84	37.03	60.07	4.05	8.83
5	11.43	55.63	3.95	9.67	36.64	55.88	3.82	9.25
6	13.72	59.97	4.23	9.56	37.89	59.93	4.16	9.13
7	16.00	60.00	4.24	9.55	37.68	59.81	4.26	9.16

SiteNo	Mileage	LFauInd	LFauAve	LFauMin	LFauMax	RFauInd	RFauAve	RFauMin
1	2.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	6.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	9.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	11.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	13.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

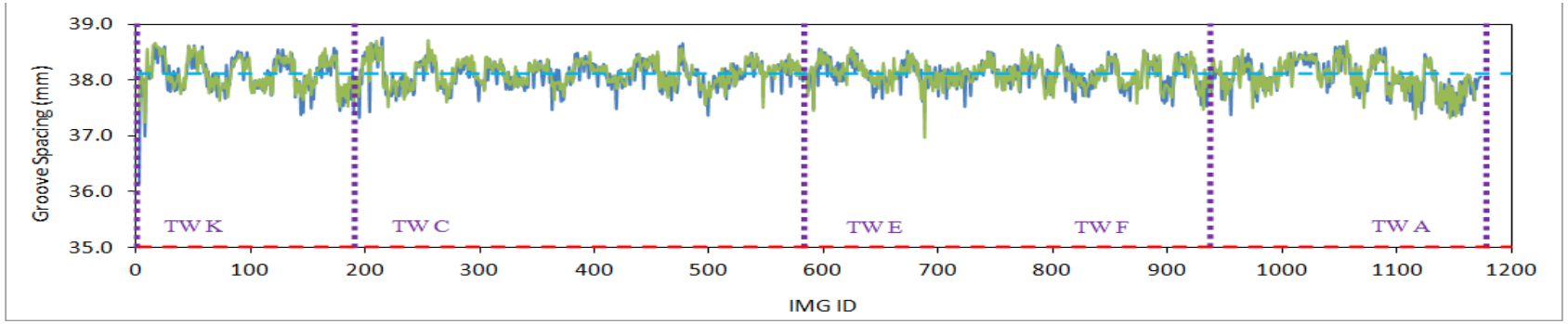
Groove Evaluation (Slab 4 Runs 7&8)



(a) Groove Depth

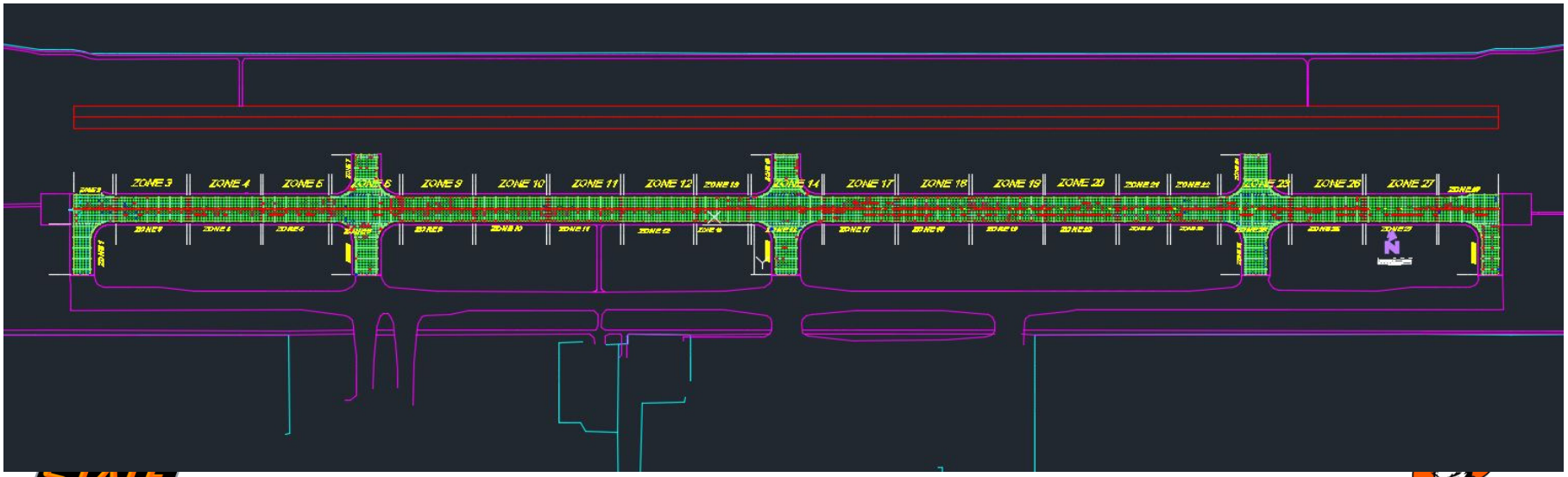


(b) Groove Width



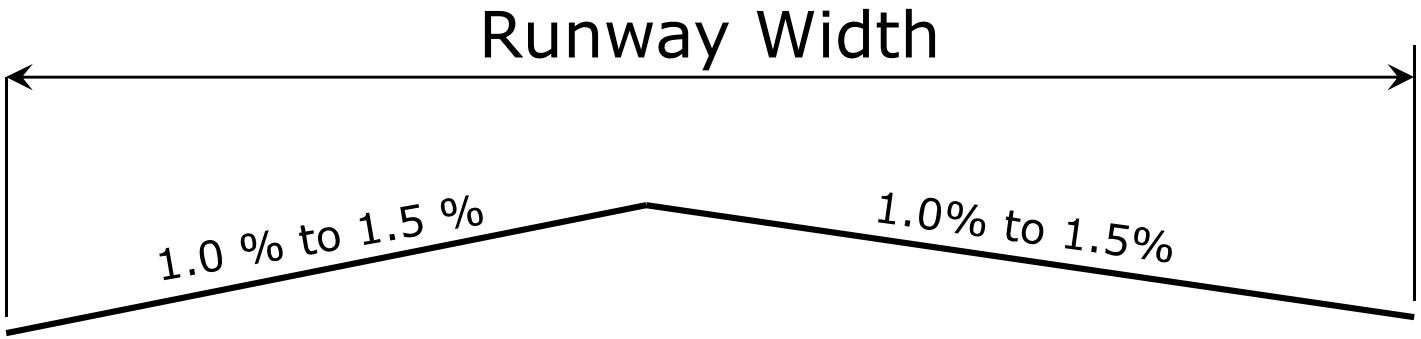
(c) Groove Spacing

Groove/Joint Evaluation

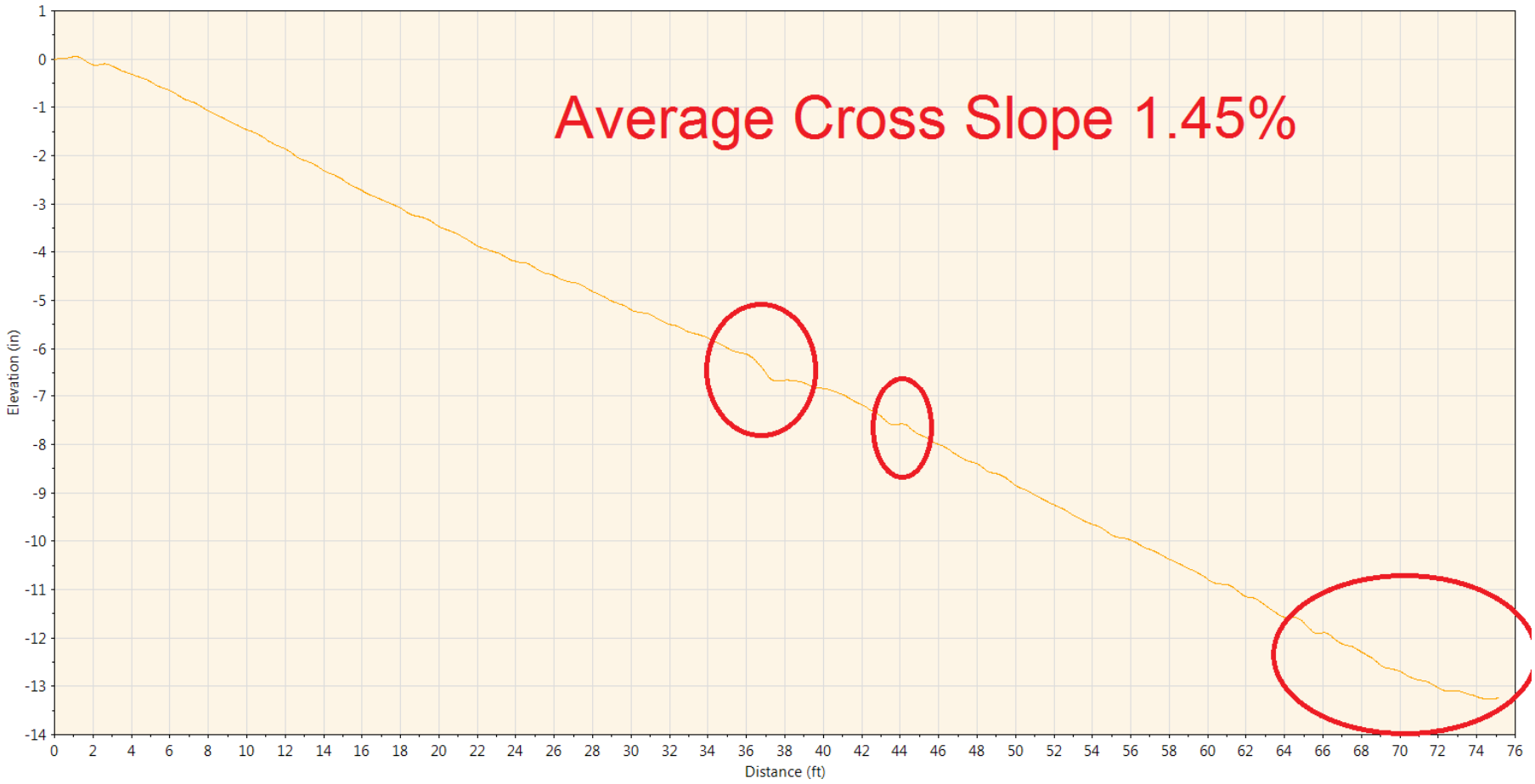


Transverse Profiling & Cross Slope

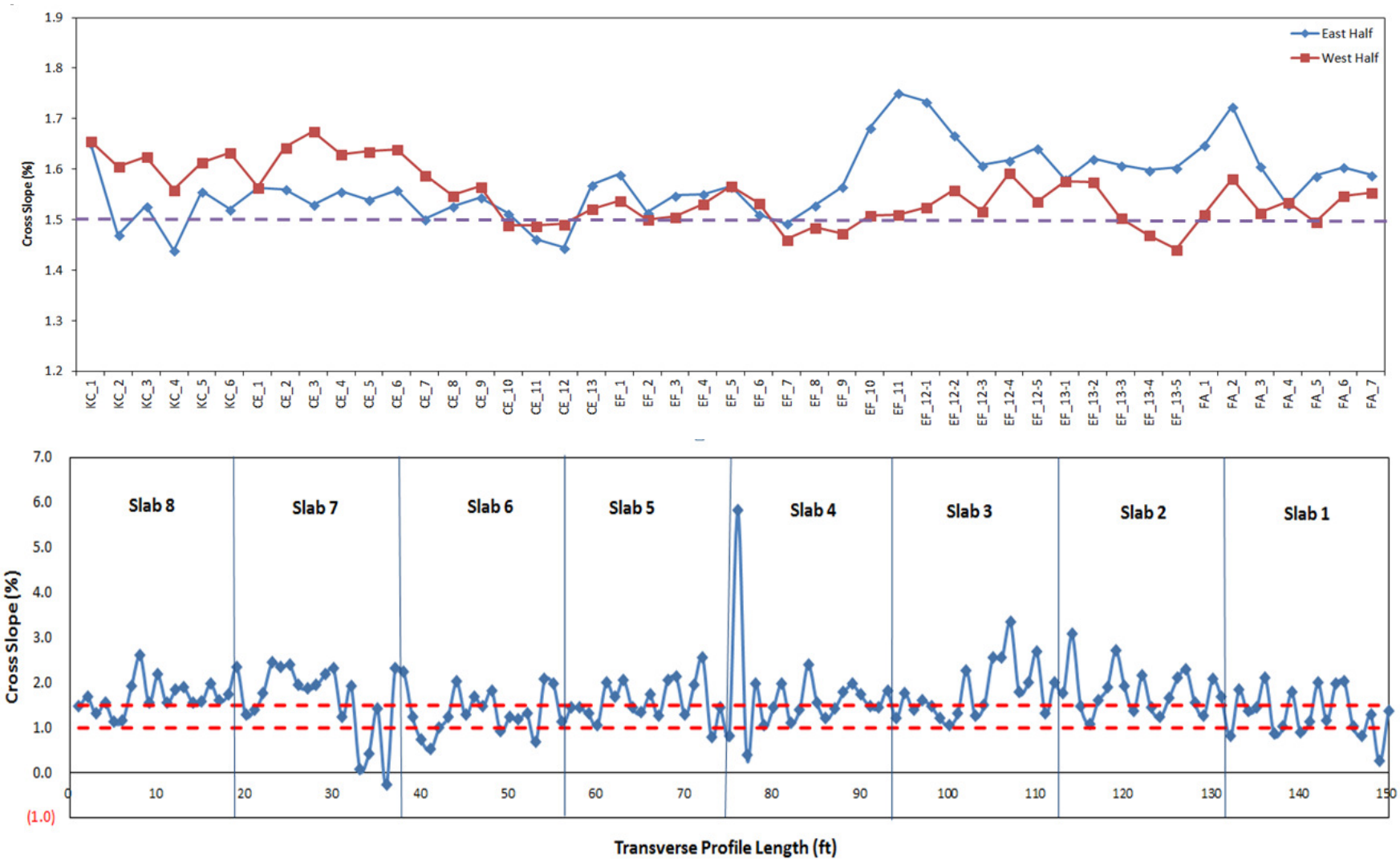
- Cross Slope Calculation
  - AASHTO method
  - TxDOT method
  - Linear regression method
- Transverse Grade – Category C & D Airports (FAA Guidance)



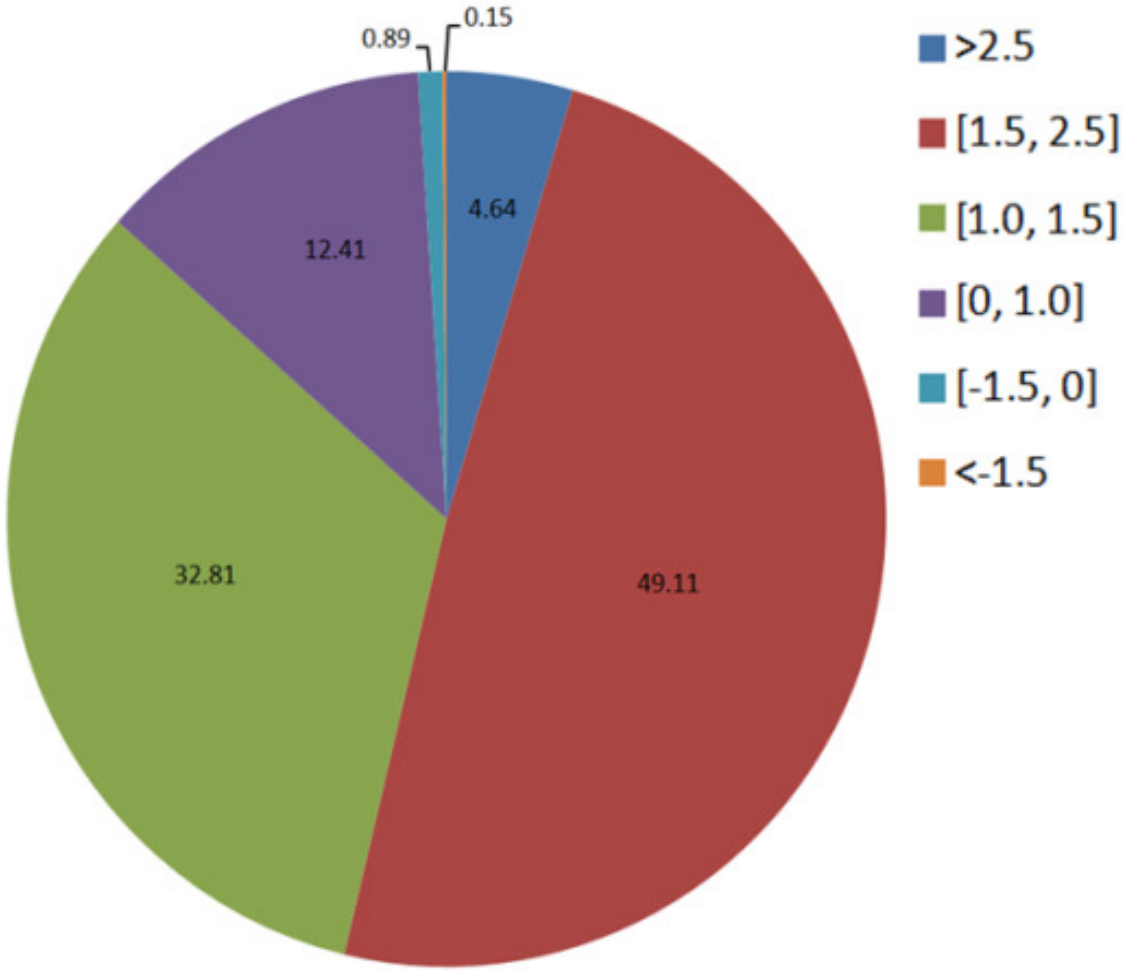
Example Cross Slope (West-Half)



Runway Cross Slope



Cross Slope Evaluation



Conclusions

- PaveVision3D Ultra
  - Able to collect 1mm surface data at 60mph for comprehensive airport runway evaluation
- Runway PCI: Excellent
  - Many construction related distresses not in PCI definitions
- Acceptable BBI
  - After runway surface grinding
- Substantial construction quality issues
  - Slab unevenness, Joint problems, Pop outs, Out-of-spec grooves, Variations of cross slope

Thank You!

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